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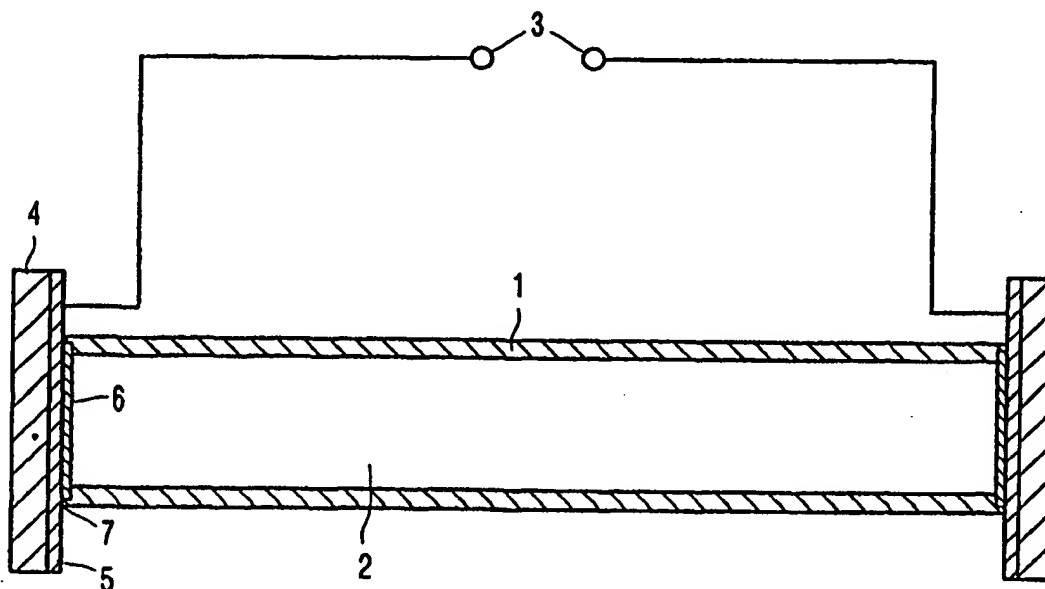
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(21) International Application Number: PCT/EP99/08936 (22) International Filing Date: 17 November 1999 (17.11.99) (30) Priority Data: 98204044.6 30 November 1998 (30.11.98) EP (71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL). (71) Applicant (for DE only): PHILIPS CORPORATE INTELLECTUAL PROPERTY GMBH [DE/DE]; Habsburgerallee 11, D-52066 Aachen (DE). (72) Inventors: BACHMANN, Peter, K.; Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL). RAUSENBERGER, Bernd; Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL). WILSON, Howard; Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL). KRAUS, Albrecht; Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL). BRAUN, Norbert; Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL). (74) Agent: BOSMA, Rudolphus, H., A.; Internationaal Octrooibureau B.V., Prof. Holstiaan 6, NL-5656 AA Eindhoven (NL).		(81) Designated States: CN, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report. <div style="border: 1px solid black; padding: 5px; display: inline-block;"> PH DE 000049EP </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-left: 10px;"> MAT. DOSSIER </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 10px;"> CIP-DE-AACHEN zugestellt am 23. Juli 2001 Frist </div>	

(54) Title: DISCHARGE LAMP



(57) Abstract

In a capacitively coupled discharge lamp the electrode (4, 5, 6) comprises a dielectric material (6) that during operation is in contact with the discharge. The impedance of the dielectric material is small and its electron affinity is negative. In this way it is realized that the discharge lamp can be operated efficiently at low frequencies (less than 500 KHz).

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Discharge lamp.

The invention relates to a discharge lamp equipped with a gastight discharge vessel containing a gas and equipped with electrodes, at least one of said electrodes comprising

- 5 - a first part that is suitable for connection to a pole of a supply voltage source and that during operation is capacitively coupled to the discharge in the discharge lamp,
- a second part formed out of a first dielectric material, said second part being connected to the first part and during operation of the discharge lamp being in contact with the discharge.

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Such a discharge lamp is known from US 2,624,858. In the known discharge lamp the first part of both electrodes is formed out of metal or deposited graphite. The second part of the electrodes is relatively thick and the dielectric constant M of first dielectric material

15 is higher than 100. During operation of the lamp the operating voltage that is applied to the first part of the first electrode and the first part of a second electrode is coupled capacitively to the discharge by means of the second part of the first electrode and the second part of the second electrode. Both electrodes form capacitive impedances during the operation of the lamp. These capacitive impedances render the current/voltage characteristic of the discharge

20 lamp positive so a separate external ballast element can be dispensed with. Since the dielectric constant M of first dielectric material is higher than 100, the capacitive impedances of both electrodes are relatively low, so that the lamp can be operated at relatively low frequencies (e.g. less than 500 KHz). An important disadvantage of the known discharge lamp, however, is that virtually each material that has a high dielectric constant also has a relatively high electron

25 affinity. Because of this high electron affinity electrons adhere relatively strongly to the surface of the second parts of the electrodes. This results in a relatively high lamp voltage, a corresponding low efficiency of the lamp and also to blackening of the wall of the discharge vessel in the vicinity of the electrodes.

The invention aims to provide a discharge lamp that during operation is capacitively coupled to a supply voltage source and can be operated by means of a low frequency (less than 500 KHz) supply voltage, with a relatively high efficiency and a relatively low amount of blackening of the discharge vessel.

A discharge lamp as mentioned in the opening paragraph is therefore in accordance with the invention characterized in that the electron affinity χ of the first dielectric material is negative.

It has been found that the negative electron affinity of the first dielectric material causes the efficiency of a discharge lamp according to the invention to be relatively high. In practice the dielectric constant of the first dielectric material is very often relatively low, e.g. lower than 10. In order to keep the capacitive impedances of the electrodes acceptably low, it is often necessary to choose the thickness of the dielectric material in the direction of the lamp current relatively small, i.e. smaller than 100 Tm, whereas the best results have been obtained thicknesses smaller than 1 Tm.

Very good results have been obtained for discharge lamps according to the invention in which the first dielectric material is chosen from the group formed by diamond, AlN, AlGa_N and BN.

Since in practice the second part of the electrode is relatively thin it is often desirable to realize electrical insulation of the first electrode part from the discharge making use of a third part consisting of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being situated between and in contact with both the first part and the second part of the electrode.

Preferably the first part of an electrode in a discharge lamp according to the invention comprises a flat metallic layer while the second part comprises a sheet of the first dielectric material parallel to the flat metallic layer. In case the electrode comprises a third part, this third part can conveniently be realized in case it comprises a sheet of the second dielectric material parallel to the first and the second part of the electrode.

It has been found in practice that it is desirable for the electrode to comprise a carrier for rendering mechanical strength to the electrode construction, said carrier being in parallel with the second electrode part. The carrier can be a separate part of the electrode but it is also possible that the carrier is formed by the first electrode part.

In case the electrode comprises a third part, the carrier can also be formed by this third part.

An embodiment of the invention will be described making use of a drawing. In the drawing Fig. 1 shows a schematic representation of a discharge lamp according to the invention, and

Fig. 2 shows a schematic representation of three alternative electrode configurations that can be used in discharge lamp according to the invention.

In Fig. 1, 1 is a discharge tube comprising a gas. 5, 7 and 4 together form an electrode and are first, second and third parts of this electrode respectively. 3 are contacts for connection to the poles of a supply voltage source. Contacts 3 are connected to the first parts of respective electrodes. 2 indicates the space enclosed by the electrodes and the discharge vessel, where the discharge is present during operation of the discharge lamp. 7 indicates a gastight seal between the electrodes and the discharge tube. In this embodiment the electrodes, the discharge tube and the seals between discharge tube and electrodes together form a gastight discharge vessel.

The electrodes were manufactured as follows. A sheet of glass (Corning 7059) was covered with a layer of titanium with a thickness of approximately 100 nm by means of evaporation. The glass sheet including the titanium layer was treated at a temperature of 600 C in a reducing atmosphere during 30 minutes. During this treatment diffusion of titanium into the glass takes place resulting in an electrically conductive and mechanically stable titanium layer. Next the titanium layer was ground with diamond powder to implant diamond particles in the surface of the titanium layer. The sheet was then covered with a diamond layer by means of a microwave CVD process carried out at a temperature of 650 C and a pressure of 15 torr. The power of the microwaves was 800 Watt and use was made of a gas mixture containing carbon, hydrogen and oxygen. The thickness of the diamond sheet was approximately 300 nm and it was H-terminated, meaning that its surface was covered with hydrogen. By making use of a mask it was realized that the diameter of the diamond layer was slightly bigger than the inner diameter of the discharge tube. The titanium layer and the diamond layer were connected to the discharge tube 1 in gastight way making use of a glass containing lead at a temperature of approximately 650 C. The lamp vessel was evacuated and filled with 5 mg mercury and 3 mBar argon. In the electrodes used in this discharge lamp the

titanium layer forms a first part, the diamond layer forms a second part and the glass forms a carrier of the electrode. By means of UV photo electron spectroscopy an electron affinity _ of approximately - 1 eV was found for the hydrogen covered diamond layer.

In all three electrode configurations 1, 2 and 3 in Fig. 2, A is a first electrode part being a layer of an electrically conductive material such as a metal. C is a second part of the electrode that is formed out of a first dielectric material. The part C is connected to the part A and the part C is in contact with the discharge during operation of the lamp. In all embodiments W is the wall of the gastight discharge vessel. In embodiments 1 and 3 the second electrode part C is directly connected to the first electrode part A. In embodiment 2 B forms a third electrode part formed out of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being in situated between and in contact with both the first part A and the second part C of the electrode. In embodiment 3, B is a carrier formed out of a dielectric material that is in contact with the the first part A of the electrode. The electrode construction in embodiment 3 of Fig. 2 is very similar to that shown in Fig 1. During lamp operation the poles of a supply voltage source are electrically connected to the first part A of the electrode.

CLAIMS:

1. Discharge lamp equipped with a gastight discharge vessel containing a gas and equipped with electrodes, at least one of said electrodes comprising

– a first part that is suitable for connection to a pole of a supply voltage source and that during operation is capacitively coupled to the discharge in the
5 discharge lamp,

– a second part formed out of a first dielectric material, said second part being connected to the first part and during operation of the discharge lamp being in contact with the discharge,

characterized in that the electron affinity χ of the first dielectric material is negative.

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2. Discharge lamp according to claim 1, wherein the first part comprises a layer of an electrically conductive material, preferably a metal, and the second part comprises a sheet of the first dielectric material parallel to the flat metallic layer.

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3. Discharge lamp according to claim 1 or 2, wherein the thickness of the second part in the direction of the lamp current is less than $100 T_m$, preferably less than $1 T_m$.

4. Discharge lamp according to claim 1, wherein the electrode comprises a third part consisting of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being in situated between and
20 in contact with both the first part and the second part of the electrode.

5. Discharge lamp according to claim 2 and 4, wherein the third part comprises a sheet of the second dielectric material parallel to the first and the second part of the electrode.

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6. Discharge lamp according to one or more of the previous claims, wherein the first dielectric material is chosen from the group formed by diamond, AlN, AlGa_{0.5}N and BN.

7. Discharge lamp according to one or more of the previous claims, in which the electrode comprises a carrier for rendering mechanical strength to the electrode construction, said carrier being in parallel with the second electrode part.
- 5 8. Discharge lamp according to claim 7, wherein the carrier is formed by the first electrode part.
9. Discharge lamp according to claim 4 and 7, wherein the carrier is formed by the third electrode part.

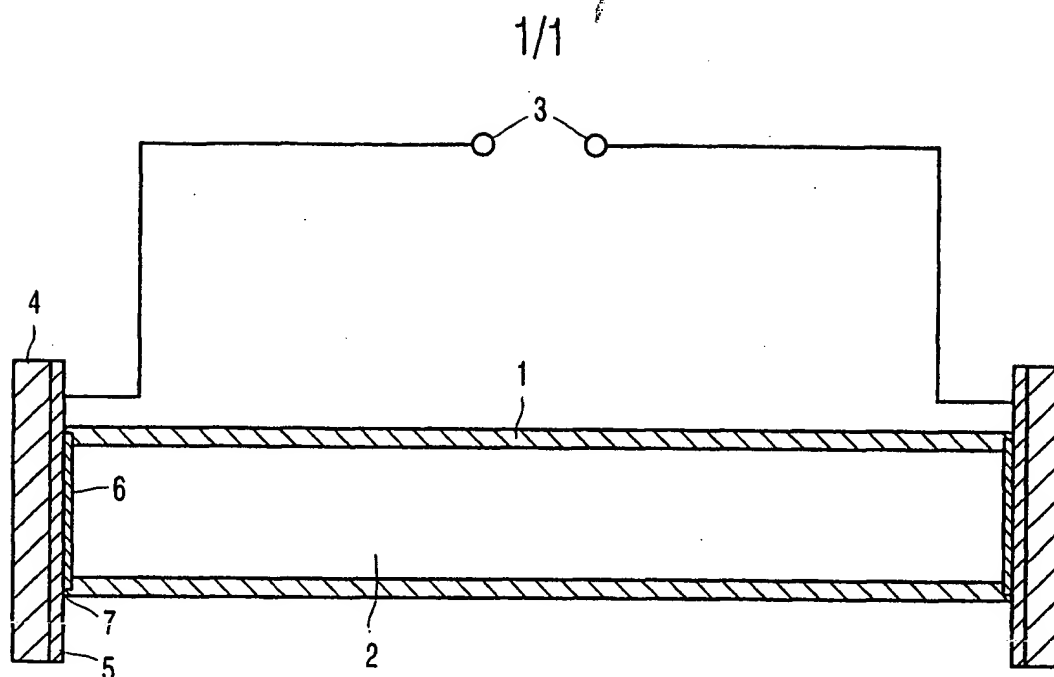


FIG. 1

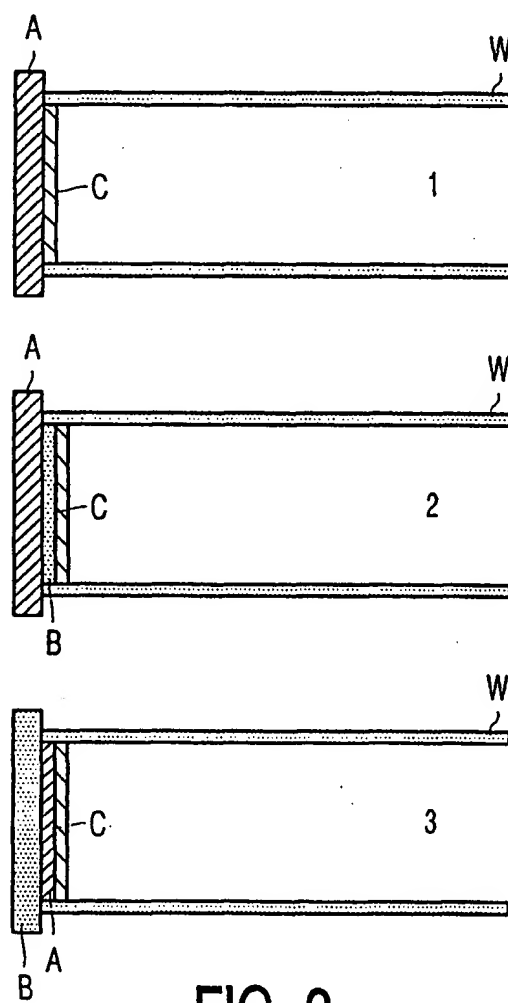


FIG. 2

PCT/EP 99/08936

IPC 7 H01J65/04

B. FIELDS SEARCHED

IPC 7 H01J

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2 624 858 A (GREEN LEE) 6 January 1953 (1953-01-06) cited in the application column 3, line 58 -column 4, line 22; figure 1	1,6
A	—	2-5,7-9
Y	GB 2 297 862 A (SMITHS INDUSTRIES PLC) 14 August 1996 (1996-08-14) claims 1,3,7,8; figure 2	1,6
A	—	
A	US 5 199 918 A (KUMAR NALIN) 6 April 1993 (1993-04-06) abstract; figure 2	1,6
A	—	
A	US 5 138 237 A (KANE ROBERT C ET AL) 11 August 1992 (1992-08-11) claims 1,2,4; figure 1A	1,6,7
	—	

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X Further documents are listed in the continuation of box C.

Y Patent family members are listed in annex.

"&" document member of the same patent family

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 180 951 A (KANE ROBERT C ET AL) 19 January 1993 (1993-01-19) claim 3; figure 7	1,6
A	EP 0 764 965 A (AT & T CORP) 26 March 1997 (1997-03-26) claims 1-4	1,3,6
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Information on patent family members

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